Na-BEARING WHITE MICAS FROM TRIASSIC ROCKS OF THE TRANSITION BETWEEN THE MALÁGUIDE AND ALPUJÁRRIDE COMPLEXES (BETIC CORDILLERA, SPAIN)

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Abstract—The structural significance of micas with Na-K intermediate composition, and their chemical and structural evolution at increasing metamorphic grade have been investigated in Triassic rocks from the transition between the Maláguide and Alpujárride complexes (Internal zones of the Betic Cordillera, Spain). Micas were studied by X-ray diffraction (XRD) and by scanning and transmission electron microscopy (SEM/TEM). Three samples, belonging to the late diagenesis and to the low and medium anchizone, were selected for this study. Na-bearing mica appears as submicroscopic packets intergrown in parallel with K-mica, becoming more compositionally uniform with increasing grade. The diagenetic sample contains illite, minor paragonite, and two main populations of intermediate Na-K micas, with average compositions Ms₆₀Prg₄₀ and Ms₃₅Prg₆₅, respectively, where Ms represents muscovite and Prg, paragonite. The lattice-fringe images of mica packets with intermediate compositions suggest the presence of random mixed-layered paragonite-muscovite. Under low anchizonal conditions the amount of discrete paragonite increases and the Na-K intermediate mica has a mean composition of Ms₄₀Prg₆₀. The TEM images suggest that the packets with intermediate composition are solid solutions of paragonite and illite. Micas with Na-K intermediate composition are lacking in the sample with the highest metamorphic grade. In this sample, paragonite and muscovite coexist with mica, with composition intermediate between paragonite and margarite. The lattice-fringe images of these Na-Ca-bearing packets suggest that they consist of irregularly shaped domains enriched either in Na or in Ca.

Our data indicate that Na+K-bearing micas have several origins: detrital stacks of K- and Na-bearing micas coexist with authigenic phases, formed from dickite in the diagenetic, coarse-grained samples, and perhaps from smectite-bearing mixed-layers or detrital illite, in the fine-grained rocks. The changes observed at increasing metamorphic grade can be related to the influence of the lithology, the metamorphic grade, and the different geological settings. Intermediate Na-Ca mica appears to have grown from paragonite, with calcite as the source of Ca.

Key Words—Intermediate Na-Ca mica, Intermediate Na-K mica, Low-grade Metamorphism, Muscovite, Paragonite.

INTRODUCTION

Micas having compositions intermediate between muscovite (or phengite) and paragonite have been identified many times in diagenetic-to-epizonal metapelites (Frey, 1987, and references therein) and in medium-grade metamorphic rocks (Guidotti, 1984; Shau et al., 1991). In most cases, intermediate compositions obtained from microprobe analyses are due to the presence of very fine-scale intergrowths of phengite and paragonite of nearly end-member composition (Ahn et al., 1985; Ferrow et al., 1990; Shau et al., 1991; Boundy et al., 1997; Martín-García et al., 1997). Nevertheless, the existence of single-phase micas with compositions within the paragonite–muscovite solvs has also been proved based on XRD and TEM data (e.g. Jiang and Peacor, 1993).

These phases were first interpreted as mixed-layered paragonite/muscovite (e.g. Frey, 1969, 1970; Kisch, 1983; Merriman and Roberts, 1985), on the basis of the presence of a series of reflections at approximately fixed positions, intermediate between those of muscovite (10 Å) and paragonite (9.6 Å), and a small superstructure reflection, in the XRD patterns. Most recently, Na-K intermediate mica has been identified in hydrothermally altered rocks (Jiang and Peacor, 1993; Giorgetti et al., 2003). These authors concluded, from detailed electron microscopic studies, that the compositionally intermediate mica was produced as a metastable phase during alteration. Li et al. (1992, 1994) described the presence of mica with intermediate Na-K composition in anchizonal mudrocks from central Wales. These authors deduced that bedding-parallel metastable mica with disordered distribution of K and Na formed from smectite during diagenesis. This intermediate mica evolved later to stable muscovite and paragonite, which follow the cleavage orientation. Livi et al. (1997) also showed an evolution from brammallite to paragonite in diagenetic to epizone-grade Liassic shales.

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